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METHOD FOR MANUFACTURING LIQUID CRYSTAL PANEL

[Abstract]

PROBLEM TO BE SOLVED: To solve such problems that in a beadless liquid crystal panel which keeps the cell gap of the liquid crystal panel by projections formed on a color filter substrate, the projections cause plastic deformation by the load on the color filter substrate in the production process and a desired cell gap is not obtained.

SOLUTION: The reduction of the projection height is evaluated as ≥ 0.15 μ m and ≤ 0.25 μ m in the printing process of an alignment film and evaluated as inversely proportional to the density of the projections per unit area, inversely proportional to

the contact area of the projections with the counter substrate and proportional to the projection height in other processes. The projections are preliminarily formed higher by the above reduction amount.

[Claim(s)]

[Claim 1] A manufacturing method of a liquid crystal panel, comprising,

a projection forming process for forming a resin projection on any one of two substrates for constantly maintaining a distance between said two substrates,

an orientation layer printing process for printing an orientation layer on the projection formed on said substrate,

a panel assembling process for assembling said two substrates for injecting liquid crystals between the substrate on which the orientation layer is printed, and the other substrate of said two substrates on which said projection is not formed,

wherein after said panel assembling process, a height of the projection formed during the projection forming process is set to a desired height by adding a reduction amount of said projection formed in said orientation layer printing process and said panel assembling process to the desired height.

[Claim 2] The manufacturing method of the liquid crystal panel set forth in claim 1, wherein in said orientation layer printing process, the reduction amount of said projection is set to above 0.15μm and below 0.25μm.

[Claim 3] The manufacturing method of the liquid crystal panel set forth in claim 1 or the claim 2, wherein in said panel assembling process, the reduction

amount of said projection is calculated and obtained based upon the fact that the reduction amount is inversely proportional to a density per unit space.

[Claim 4] The manufacturing method of the liquid crystal panel set forth in any one of claims 1 to 3, wherein in said panel assembling process, the reduction amount of said projection is calculated and obtained based upon the fact that the reduction amount is inversely proportional to a space of a side contacting said one substrate.

[Claim 5] The manufacturing method of the liquid crystal panel set forth in any one of claims 1 to 4, wherein the reduction amount of said projection in said panel assembling process is calculated and obtained based upon the fact that the reduction amount is inversely proportional to a height of a projection in said orientation layer printing process.

[Title of the Invention]

METHOD FOR MANUFACTURING LIQUID CRYSTAL PANEL

[Detailed Description of the Invention]

[Field of the Invention]

The present invention is related to a manufacturing method of a liquid crystal panel using a projection for injecting a liquid crystal material between two substrates and for maintaining a distance between said two substrates constantly.

[Description of the Prior Art]

A conventional technology will be explained by referring to FIG. 3.

A liquid crystal panel is formed by bonding two substrates, but it is necessary to arrange a spacer for maintaining a gap between two glass substrates 11, 12 constantly. In the prior art, a spacer is formed by distributing ball-shaped beads 51 or inorganic ball-shaped beads 51 made of a resin of divinylbenzene or benzoguanamine on any one of two glass substrates 11, 12 and bonding two substrates.

Said beads distribution method is applied to the assembling process of most LCD panels, which are now being produced because of its convenience.

But, recently, as the display quality improvements of LCD panels are

demanded, following improvement points are demanded. That is, (1) display non-uniformity or contrast deterioration generated because of dispersed beads 51, and light leakage from its periphery, or light leakage due to bead coagulation in case of distribution, (2) improvement of a cell gap uniformity, (3) deterioration of a cell gap uniformity due to movement of particles 51 of beads when a vibration is applied to a LCD panel, or a scratch of a surface of an orientation layer 4, (4) when concentrated load is applied to some parts of a LCD panel, a cell gap non-uniformity generated since the beads 51 is transferred to the color filter layer 3.

In order to solve these problems, recently, a projection which is made of a resin, and has a predetermined space and an uniform height is formed as a spacer for maintaining a cell gap on the color filter layer 3 by using a method such as a lithography. A structure which omits the distributed beads 51 (i.e., a beadless structure) is studied, and it is being already applied to some products.

But, since the projection made of resin formed on said color filter layer has severe plasticity change, and a heavy load is applied to the color filter pattern 11 during an orientation layer printing process (a seal printing, seal hardening, a vacuum injection, and an inlet sealing) after forming a projection, and subsequent panel assembling process, the height of a projection becomes lower and thus a desired cell gap can not be obtained.

[Means for Solving the Problem]

In order to solve above-mentioned problems, a manufacturing method of a liquid crystal panel according to the present invention, the reduced amount (plasticity change amount and elasticity change amount) of a projection height is calculated in advance during the orientation layer printing process and the panel assembling process. A projection having a height obtained by adding a height corresponding to an estimated amount to a desired height after the panel assembling process is formed during a projection forming process.

In the orientation layer printing process, the reduced amount of a projection height is set to 0.15μm - 0.25μm, irrespective of a density per an unit space of a projection, a space of a side contacting with a substrate on which a projection is not formed, and a projection height after the orientation layer printing process. Then, it is understood that during the panel assembling process, it is inversely proportional to a density per an unit space of a projection, or is inversely proportional to a space of a side contacting with a substrate on which a projection is not formed, or is proportional to a projection height after the orientation layer printing process.

[Embodiment of the Invention]

A manufacturing method of a liquid crystal panel of the present invention comprises a projection forming process for forming a resin projection on any one

substrate of two substrates for maintaining a distance between said two substrates constantly, an orientation layer printing process for printing an orientation layer on the projection formed on said substrate, a panel assembling process for assembling said two substrates for injecting the liquid crystal between one substrate on which the orientation layer is printed, and the other substrate of said two substrates on which said projection is not formed, wherein after said panel assembling process, the height of the projection formed during the projection forming process is set to a desired height by adding a reduction amount of said projection formed in said orientation layer printing process and said panel assembling process to the desired height.

Further, according to a manufacturing method of a liquid crystal panel of the present invention, in said orientation layer printing process, the reduced amount of said projection height is set to above 0.15μm and below 0.25μm.

Further, according to a manufacturing method of a liquid crystal panel of the present invention, in said panel assembling process, the reduced amount of said projection height is calculated and obtained based upon the fact that the reduction amount is inversely proportional to a density per unit space.

Further, according to a manufacturing method of a liquid crystal panel of the present invention, in said panel assembling process, the reduced amount of said

projection height is calculated and obtained based upon the fact that the reduction amount is inversely proportional to a space of a side contacting said one substrate.

Further, according to a manufacturing method of a liquid crystal panel of the present invention, the reduced amount of said projection height in said panel assembling process is calculated and obtained based upon the fact that the reduction amount is inversely proportional to a height of a projection in said orientation layer printing process.

Below, the embodiment of the present invention will be explained with referring to FIG. 1 and FIG. 2.

The processes for preparing a color filter substrate 11 for 13.3 inch XGA, and assembling a TFT LCD panel of 13,3 inch XGA are performed according to a manufacturing method of the present invention.

First of all, after general processes are completed, a black matrix is formed by a pigment photo method, and sixteen color filter pattern 12 (a-1, a-2, b-1, b-2, c-1, c-2, d-1, d-2, e-1, e-2, f-1, f-2, g-1, g-2, h-1, h-2) for 13.3 inch XGA on which a color filter layer 3 and a transparent electrode 8 are formed on the black matrix are prepared.

An acrylate resist material is coated on said color filter substrtae 11 by a spin-coat method, and the steps such as a pre-bake, an exposure of ultraviolet rays

through a mask of a predetermined pattern, development and a post-bake are performed, thereby forming a projection 52.

At this time, the projection 52 has a shape without a top of a cone shown in FIG. 2. In addition, The projection 52 on sixteen color filter pattern are formed such that the projection height, a density per an unit space, and a space (upper bottom and lower bottom) are different from each other by adjusting a coating layer thickness of an acrylate resist material, and exchanging a pattern mask in case of exposure. A measured results of a height, a density per an unit space, and a space (upper bottom and lower bottom) of a projection 52 on sixteen color filter pattern 12 (a-1, a-2, b-1, b-2, c-1, c-2, d-1, d-2, e-1, e-2, f-1, f-2, g-1, g-2, h-1, h-2) are listed in Table 1.

Table 1

Substrate

Density number/dot, number/mm2

Height of a projection : μm.

Space : upper bottom : μm2

lower bottom : μm2.

Further, as for the pattern pitch, a width is set to 99μm, and the length is set

to 297μm.

Further, one pixel is composed of 3 dot including R, G and B each of which includes 1 dot, respectively.

Next, eight array substrates 12 adhered to a color filter substrate 11 at the opposite side are prepared. The measured layer thickness of an array wiring of the position where a projection of the array wiring is contacted is 1.22μm.

A substrate cleaning and an orientation layer printing are applied to the total 24 color filter substrate 11 and the array substrate 12. 8 color filter patterns (a-1, b-1, c-1, d-1, e-1, f-1, g-1, h-1) are pulled out, and the height of a projection 32 is measured. The measurement results are listed in Table 2.

Table 2

Substrate

Density number/mm2

Initial projection height : H1μm.

Height of a projection the orientation layer printing process. : H2μm.

The reduced amount of height : H1-H2μm.

From Table 2, it is understood that the height of a projection 52 is reduced due to a process after the orientation layer printing process. The reduced amount of

height s considered to be generated since the projection 52 is not influenced by a density, a space, and a height per an unit space of the projection 52, and the range of measurement precision, and it ranged from 0.15μm to 0.25μm.

An orientation layer hardening, a rubbing process, a and cleaning after the rubbing process are formed for remaining 8 color filter pattern 11 and an array substrate 12. Then, a seal printing is applied to the color filter pattern 11 and a conducting paint coating is applied to the array substrate 12. At this time, a glass fiber of 2.0% having a fiber length of 5.2μm is mixed into the seal material.

After an array substrate 12 is adhered on these 8 color filter pattern substrate 11, a seal hardening, the processes such as a glass separation and cutting, a vacuum injection, and an inlet sealing are performed, and thereby producing a LCD panel.

Finally, the cell gap of produced LCD panel is measured, and the height of a projection 52 is calculated from the measurement results. These measurement results are listed in FIG. 3.

Table 3

Substrate

Density number/mm2

Upper bottom of a space : μm2

Cell gap : μm

Height of a projection after a projection the orientation layer printing process. : H2μm.

Height of a projection after assembling : H3μm

The reduced amount of height : H2-H3μm.

Height of a projection after wiring assembling

= (a cell gap) - (the layer thickness of an array wiring).

The layer thickness of an array wiring : 1.22μm

From Table. 3, it is understood that the height of a projection 52 is reduced in a process after the orientation layer printing process. This change is considered to be generated since the projection 52 is adhered on the substrate excessively, during a seal hardening process, a vacuum injection process, an inlet sealing process. As for the reduced amount of the projection 52, it is estimated that there are some deviations of the measurements, but it is inversely proportional to the density per an unit space of the projection 52, and is inversely proportional to the space(in FIG. 2, the space of an upper bottom on the projection 53) of the side contacting an array substrate 12 facing the projection 52. And, it is inversely proportional to height of the projection after the orientation layer printing process.

Based upon the relationships obtained from this estimation, in the pattern design, it is possible to acquire the reduced amount of the projection height based upon the parameters such as the density of a projection, a space of an upper bottom, and a cell gap and so on.

From the above results, in order to keep the cell gap of LCD panel constantly, in a manufacturing method of a liquid crystal panel on which a projection made of a resin is formed on one of two substrates, it is necessary to set the projection height higher in advance by measuring the reduced amount of the projection height during the panel assembling process.

[Effect of the Invention]

In this way, according to the manufacturing method of a LCD panel of the present invention, it is possible to obtain a desired cell gap stably.

[Description of Drawings]

FIG. 1 is a drawing of a LCD panel manufactured according to the manufacturing method of a LCD panel of the present invention.

FIG. 2 is a drawing showing a projection shape.

FIG. 3 is a drawing showing schematically a LCD panel manufactured according to the beads distribution method of a prior art.